Summary of Plenary Sessions

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The New England Regional Climate Change Impacts Workshop alternated between plenary sessions, where representatives of stakeholder groups and research scientists presented issues and information related to climate change impacts, and smaller, discussion-oriented breakout sessions organized by stakeholder group. This section of the report summarizes the workshop plenary sessions.[1]

Welcome Address

The conference opened on September 3, with **Berrien Moore III**, Director of the University of New Hampshire's Institute for the Study of Earth, Oceans and Space (EOS), and **Joan Leitzel**, President of the University, extending their greetings and introducing the day's events. President Leitzel specifically mentioned the importance of climate and weather to the quality of life in New England and the research leadership of the University in the areas of climate change and variability.

Introductory Remarks

Robert Corell, Assistant Director for Geosciences at the National Science Foundation and an expert on climate, described the natural forces contributing to global change. His talk addressed geological and recent history, and the influence of human population and technology over the last several centuries. He briefly reviewed the work of the U.S. Global Change Research Program (USGCRP) and the Intergovernmental Panel on Climate Change (IPCC), and asked attendees to consider the likely effects of climate change in New England.

Corell said scientists and citizens need to:

1) seek to observe and document what "is really going on,"
2) try to understand climate change on global, regional and local scales,
3) attempt to predict future climate change/variability,
4) assess the level of confidence in those predictions,
5) analyze the regional and local knowledge base, level of understanding and additional information needs regarding climate change, and
6) decide on a course of action.

Corell stated the importance of "getting more sophisticated about how we (climate change scientists) describe what we do," to the public and the press, i.e.,, the need for "a whole new lexicon" for the Earth system changes and variability that scientists observe and anticipate.

Norman Willard, Climate Change Coordinator for the U.S. Environmental Protection Agency (EPA), New England Region, welcomed attendees and briefly described EPA's new Global Warming Network for state and local governments in New England, created to provide "greater public awareness through education and outreach" on a "very aggressive" basis.

WORKSHOP CHARGE

Jerry Melillo, Co-director and Senior Scientist at the Marine Biological Laboratory in Woods Hole on Cape Cod, helped to establish the workshop series as a way to emulate the IPCC assessment process regionally and nationally within the United States. His four questions (outlined in the Introduction, page 10) provided the framework for attendees to organized their discussions in the breakout sessions.

STAKEHOLDER PERSPECTIVES ON REGIONAL CLIMATE CHANGE ISSUES

Steven Hamburg, Associate Professor at Brown University, chaired the first panel on stakeholder perspectives of regional vulnerabilities. He spoke briefly about how climate change could affect "sense of place" experienced by residents and visitors of New England. According to Hamburg, the issue is not purely one of change, because there have been major changes here in the past

* See Appendix V for authors' affiliations and addresses.

[1] Separate papers prepared by some of the invited speakers and members of the Steering Committee can be found in Appendix VI.

three or more centuries. The issue is rather one of rapid and unfavorable directions of change, that will likely diminish agricultural productivity, recreational opportunities, the enjoyment of rural life in the region, and quite possibly increase the cost of maintaining these elements of New England life.

Natural Resources — Independent forest industry consultant **Lloyd Irland**, President Irland Group, from Winthrop, Maine, objected to apocalyptic predictions of global warming effects, because they make it easy for skeptics to dismiss warnings as "sky is falling" rhetoric. Further, they create the danger of a "politically correct" orthodoxy on this subject that makes honest scientific debate more difficult. Irland described the importance of natural resources to New England's economy, taken overall, but the much greater importance to specific rural communities where farming, forestry, fishing and recreation predominate. He distinguished the degree of vulnerability to climate change among natural resource users as follows:

- In the short-term, forest landowners and fishing operations are less vulnerable as they exploit "standing crops" whose abundance and replenishment is typically determined by long-term management and environmental trends.
- Farmers and recreation/tourism managers, subject to seasonal or annual conditions, are more vulnerable to climate variability because sudden events cannot be easily predicted or avoided.

Irland said that his clients are probably less concerned about climate change than they are about short-term losses from crop failure, floods, freezes, and market fluctuations. Many stakeholders fear the immediate impacts of policies adopted to mitigate climate change, which affect their businesses now, while the adverse effects are of uncertain magnitude and occur in the distant future. He was reserved about taxes on carbon emissions—unless they were applied worldwide—saying that companies would just transfer their pollution problems to less restrictive countries.

Human Health — **Amy Langston**, Disease Database Coordinator for the Center for Health and the Global Environment at Harvard University, presented a report of environmental health and disease trends written by her colleague Paul Epstein. Many new diseases of humans, agriculture, wild plants and animals have appeared in recent years; many old ones have reappeared and many existing ones have spread. This is likely due to warmer and wetter conditions caused by climate trends or by severe episodes of drought, floods, storms, etc. Langston noted that health effects from climate change and variability are due to both chemical and physical changes in the atmosphere, at the Earth's surface, and in lakes, rivers, streams, estuaries and oceans. Opportunistic pathogens having fast reproductive cycles can take advantage of favorable short-term growing conditions to explode in numbers and establish themselves in new locations. Additionally, warmer temperatures permit agricultural pests and other disease vectors to overwinter without harm and thus begin the new year with greater numbers.

Insurance/Business and Industry — **James Russell**, Vice President of the Institute for Business and Home Safety, discussed why insurers are experiencing more frequent and higher damage claims from disasters, especially earthquakes, flood, hail, wild fires, and wind. He said property owners continue to develop and occupy dangerous locations such as coastlines, flood plains and dry forests; in fact, their exposure is increasing despite government and insurance industry efforts to discourage the trend. Russell said, "American society views insurance as an entitlement," and doesn't want to pay for premiums commensurate with the risks. Russell praised FEMA's new mitigation program and asked workshop attendees to support efforts to help reduce or eliminate the frequency and severity of disasters. All the same, however, he said that American insurers, have not yet accepted scientists' conclusions about climate change.

Energy and Utilities — **James Platts**, Senior Engineer from Northeast Utilities, said that utilities probably produce a third of the carbon dioxide emissions in the United States. He reported that several hundred utilities have pledged to reduce their carbon emissions by a total of more than 40 million metric tonnes per year toward an original government target of 100 million tonnes; a revised government target, however, is now in the 200-250 million tonnes range. Platts called for a plan to move toward zero-emitting electricity generation. Northeast Utilities is in the research and development stage for landfill methane recovery and for wind power, but he did not estimate how much of the pledged reductions for New England could come from such projects.

Government and Resource Management — **Robert Brower**, Director of Cayuga County Planning in upstate New York, provides various local governments, their agencies and municipal organizations with high-tech mapping data for landuse decisions with environmental, economic, health, and community consequences. He uses geographic

information systems (GIS), geographic positioning systems (GPS), a geodetic reference system (GRS) and Internet web sites to analyze data on more than 700 square miles in the Cayuga County, NY Finger Lakes region.

He observed that climate change coping strategies in New England will require the policy involvement of local government entities where landuse control is vested. He pointed out the existing institutional complexity in New York State, where more than 1600 municipal civil divisions currently exist. Additional governmental entities with landuse implications (e.g., sewer and water districts, zoning commissions, planning boards) increase this number in New York to an estimated 10,000 entities.

Brower said satellite imagery and anticipated data from NASA's Mission To Planet Earth will help Cayuga County understand its relationship with neighboring regions and the need for environmentally-responsible landuse policy, decisions and enforcement. He expressed concern, however, about the effects of the devolution of federal responsibility that transfers important, quality-of-life programs to ill-prepared and poorly funded state and local governments. Additionally, he was concerned about the public's general disengagement from civic involvement at all levels. He felt that these two issues need to be addressed.

Recreation and Tourism — **Ken Kimball**, Director of Research at the Appalachian Mountain Club (AMC), reported on the importance of tourism in New England's economy (in New Hampshire, tourism accounts for nearly 10% of the state's gross product). The AMC has projected that climate change in New England, when added to pollution, will damage the region's tourist economy by stressing forest, streams, lakes, wildlife and fish, obscuring scenic vistas, and endangering visitors' health.

Working with health researchers and public health officials, the AMC has shown that a visitor's health may be adversely impacted by engaging in recreational activities (hiking). Visitors are cognizant of the deterioration in both scenic visibility and landscape. Kimball found it ironic that the "recreation and tourism industry in New England is very dependent on a highly mobile public using the automobile as its primary source of transportation to travel long distances. Automobiles are a significant source of the chemical precursors that form ozone; their combustion of fossil fuels also makes major contributions to increased carbon dioxide levels."

KEYNOTE ADDRESS

Daniel Goldin, NASA Administrator, gave a luncheon keynote address that highlighted NASA as a non-political global change research and knowledge producer within the federal government. He took pride in relating one story about grade-school students in rural Maine who mastered the skills for retrieving and working with NASA's Earth Observation System imagery as a result of participating in a UNH education outreach program. Goldin detailed how NASA learned to detect Pacific Ocean El Niño events through remote sensing of sea surface temperature, ocean surface topography to within inches of accuracy, wind speed and direction, and by working cooperatively with scientists and their satellites at the French and Japanese space agencies.

Goldin cautioned against the myopia that comes from working too exclusively with either local issues or global problems. He advised a combined approach, where research was reinforced by good peer review science and cooperative programs that reached all the way from the satellite to the classroom, and from the factory floor to Capitol Hill. Goldin stated his operating slogan as "Predict, Prepare and Prevent." He pledged NASA's resources to launch "the most aggressive constellation of spacecraft in the history of the planet" that will someday make possible the multi-decade predictions of changes in climate, environment, atmosphere, oceans and land. He promised to salvage the malfunctioning Lewis hyperspectral research satellite or to launch a replacement as quickly as possible so that scientists can make extremely fine measurements of Earth's environmental processes.

The "Now" Climate

Norman MacDonald, Meteorologist and retired network television weather forecaster, explained the "now" climate and described how New England's "wait-a-minute" weather results from being at the end of the continental flow of air and the resultant interplay between high and low pressure systems from both the western and southern United States. He recalled improvements in forecasting accuracy and speed that came with computers, weather satellites and weather radar. While these tools have dramatically improved our ability to make accurate forecasts one to three days ahead, good 4-10 day forecasts are still very difficult to make.

MacDonald discussed the distinction between weather forecasting and climate forecasting, the latter still being very difficult because of the large

NASA Administrator Daniel S. Goldin, Nancy Maynard, Acting Director, Science Division, Office of Earth Science, Dr. Janet Campbell, UNH, and Dr. Berrien Moore, Workshop Co-chair, discuss climate change issues during the workshop luncheon.

mix of factors besides high and low pressure systems, air flow, temperature and humidity; namely, atmospheric chemistry, greenhouse gases, ocean circulation, solar radiation, geological forces and other long-term Earth processes and cycles. MacDonald believes that climate models insufficiently capture critical transients or extreme events, weakening their accuracy. Finally, he briefly described the history of extraordinary New England weather events, noting that the frequency of damaging hurricanes and snowstorms did not seem to be trending up or down but that the intensity of nor'easters may be increasing. "In summary," said MacDonald, "there is no question in my mind that climate will change in New England, as it will across the globe. The question is, will it be dramatic?"

THE "PAST" CLIMATE

Paul Mayewski, Director of the Climate Change Research Center at UNH-EOS, gave a "past climate" view of Earth's climate variability that scientists have assembled from ice cores taken from deep within glaciers and icefields around the world.

There are at least three important aspects of this research:

1. The science has matured to where ice layers and their contents can be retrieved and analyzed to within fractions of a year; the longest core record goes back 250,000 years. Thus, ice contains a record of atmospheric gas concentrations and particulates frozen in time that can be compared with other events known or suspected to have occurred in recent times or in prehistory.
2. Mayewski showed how some ice core records correlate well with the decline of the Mesopotamian empire in approximately 2200 B.C., and the occupation of Greenland by Norse colonies from 1000-1400 A.D. Scientists have shown that certain chemical and physical "signatures" in the ice can tell when events occurred and also point to the origin of various particles, gases, ions and compounds.
3. Oscillating patterns of ice layer thickness and contents may occur at regular intervals and reflect certain Earth and solar processes, sometimes foreshadowing the beginning of a new climatic era or the end of an old one. Some patterns seem to indicate that long periods of drastically new climate can set in after only a few years of irregular and extreme weather.

Mayewski and others want to determine whether they can match these historical patterns to the more recent erratic climate record to try to predict the characteristics of the next era—locally, regionally and globally.

THE SCIENCE OF CLIMATE CHANGE: A PANEL DISCUSSION

John Aber, Professor and a terrestrial ecologist from Complex Systems Research Center of EOS at the University of New Hampshire, chaired the panel of experts that opened the day's events on Thursday. Aber commented on the need to communicate to the public the Earth systems science background necessary to understand climate change and variability, stating that climate change needs a "Carl Sagan." He keyed his remarks to four words: complexity, uncertainty, trust and communication. Aber cited the need to "distill [the complexity of ecosystems] to its important components...make it interesting to people so that they want to know it, not just because they fear it, but because they find it fascinating."

Aber explained that trust is the high level of agreement and acceptability scientists seek from others, in and beyond their profession. In trying to make predictions from the data and trends, there are degrees of uncertainty because predictive tools, like models, only approximate outcomes; they do not give 100% certainty. Aber noted that trust prevails when there is a common understanding of the tremendous effort and motivation to tell the truth about the causes and effects of, in this case, climate change and variability. Finally, the desired understanding comes from constant communication about the near and long-term significance of global changes to people and the planet.

Ecosystems — **Ivan Fernandez**, Professor of Soil Sciences at the University of Maine, reviewed the effects of pollution on New England ecosystems, and in particular, forests. Forests have been contaminated and damaged by acid rain, heavy metals, ozone, increasing ultraviolet radiation, fertilization from atmospheric nitrogen and carbon dioxide. According to Fernandez, New England's forests are experiencing the combined growth-promoting effects of three factors:

- increased atmospheric carbon dioxide,
- elevated temperatures, and
- nitrogen deposition from acid rain.

"Although some people suggest that these factors may have a positive impact on forests, we don't know a lot about how these things interact," said Fernandez. "We are just really at the point of studying individual factors. We know less about episodic processes." As climate change continues, forest managers will try to adapt by altering tree cutting practices, forest stand composition, artificial regeneration, pest control and use of fire.

Climatology — **Barry Keim**, New Hampshire State Climatologist and a specialist in the study of severe weather, described his attempts to detect changes in the frequency or intensity of severe weather events in recent years in New England. He presented numerous examples of catastrophic events in the Northern Hemisphere, some of which appear to represent greater incidence of extreme events. But, he cautioned, this may also be due to better reporting, increased awareness and population growth—that is, more witnesses of severe weather. "What we are trying to sort out at this point, is whether or not this is real or media hype or some signal that the global climate is changing," said Keim.

Keim pointed out that the severity of events is often not measured by physical or chemical parameters but by social or economic ones. He gave the example of weather-related catastrophes in recent years being measured by dollars of damage or level of insurance claims. He also discussed the limits of global circulation models (GCMs) in predicting extreme events, especially because their scale of prediction (spatial or temporal) may be too large—decades or continents, rather than seasons or regions—to capture them. He agreed with Norman MacDonald that there is tremendous variability in the record of extreme events—so much that it may be very difficult to predict much in the way of climate change. He also agreed that temperature is trending upward, although with much inter-annual variability. For example, there seems to be a recent trend toward milder winters, as measured by decreasing days of below-zero temperatures in New Hampshire.

Keim emphasized that current models of climate change predict greater changes will happen farther from the equator, hence a changing gradient between tropical and temperate zones. If weather is seen as atmospheric behavior "trying to mix and bring more homogeneous types of conditions," Keim speculated that global warming might then moderate rather than worsen the frequency or intensity of extreme events. As for the frequency and intensity of nor'easters and heavy rainfalls, both of which may be increasing, he noted: "It appears that something is going on but what it is we don't really know."

Natural Resources — **Allan Auclair**, a forest researcher and Senior Scientist with Science and Policy Associates in Washington, D.C., discussed how sudden seasonal climate changes may be triggering forest dieback in New England and southern Quebec. Auclair traced these occurrences to periods when mid-winter temperatures prema-

turely warmed for a few weeks—promoting thawing and flow of tree sap—and then suddenly fell back to very cold temperatures, freezing the sap and damaging the trees' roots and conduction system. He proposed this as a major cause of forest damage, distinct from and perhaps more serious than acid rain.

The thaw-freeze effect is exacerbated by an apparent trend toward less snow cover—which means less protection for roots when temperatures become extremely cold. Trees experimentally deprived of snow cover had slower and more stunted growth later in spring and summer. Auclair believes there is a correlation between El Niño and thaw-freeze events. "Indeed, over this period [since the mid-1970s], it seemed that the El Niño and freezing stress patterns show a stronger correlation (two to three-fold) than what the long-term historical pattern has been." With the current year being predicted to be a strong El Niño year, Auclair anticipates significant thaw-freeze events in New England this winter.

Sea-level Rise — **Graham Giese**, Research Specialist on sea-level rise at the Woods Hole Oceanographic Institute, reported on the loss of coastal land from ocean erosion versus the passive submergence (sea-level rise) and occupation of coastal uplands caused by marshes retreating from sea-level rise. Giese reviewed the history of New England's coastline immediately after the Ice Age, when land extended to Georges Bank and Nantucket Shoals, evidenced by the remains of mammoths and mastodons in sea sediments. With subsequent sea-level rise and also, in his opinion, subsidence due to a sinking continental shelf, the coastline retreated—a process that is continuing today.

Giese mapped and compared the loss of coastal land in Massachusetts to both direct erosion and loss of uplands by passive submergence. On Cape Cod, he found that upland loss to passive submergence exceeds upland loss to active erosion by approximately 3:1. Sea-level rise of uplands in all of coastal Massachusetts results in the loss of approximately 65 acres per year.

Agriculture — **David Wolfe**, Associate Professor of Agriculture from Cornell University, discussed possible agricultural impacts from climate changes in New England. A warming trend could drive upstate New York away from its leadership in production of cabbage, apples, and other commodities well-adapted to our current climate. Increased summer temperatures would stress cow herds, affecting milk production in the New England dairy industry. A warming trend, coupled by higher atmospheric carbon dioxide concentrations, might increase production of some warm-season crops, but this will likely require an increase in fertilizer and water inputs. Wolfe explained that most classical growth experiments with high carbon dioxide have not replicated the sub-optimal conditions that some New England farmers will face; further, even with a warming trend, our spring temperatures may be too cool for maximum carbon dioxide benefits to occur. More plant growth also means more weeds, and warmer temperatures will increase insect pest pressure. This will lead to higher chemical inputs for control just when farmers in the region are trying to reduced those applications because of water quality concerns.

According to Wolfe, climate change may require a major shift in crops but "there hasn't been a comprehensive analysis for the New England area and what it might mean." Thus, substitutions of crop types may or may not be economically feasible. Wolfe predicted intense competition among growers and expects New England's future food production to become a major political and social issue. "New England agriculture should be able to adapt to climate change," concluded Wolfe. "However, those adaptations are going to be costly and could have adverse environmental impacts. There will be losers as well as winners, and the transition will be economically and politically stressful...."

A CLIMATE CHANGE CASE STUDY: THE ALASKA EXPERIENCE

Glenn Juday, Associate Professor of the Forest Sciences Department at the University of Alaska-Fairbanks, reported that climate change is underway "with a vengeance" in his state, trending towards warmer winters with heavier snowfall and warmer, but drier summers. The impacts include earlier than average ice-breakups on the Tanana River, in Fairbanks, extensive warming of permafrost south of the Yukon River, declining birch and spruce tree growth, problems in white spruce reproduction, large areas of tree death from spruce bark beetles, and higher stream temperatures that are associated with poor returns of spawning salmon.

Juday believes that a "powerful and significant climate regime shift unprecedented in at least the twentieth century and probably for the past 400 years—consisting of warming and summer drying—has occurred" in interior Alaska. He does not

know whether to attribute this to greenhouse gas induced global warming or to other factors. Reports suggest that there is a connection between the "shift" and El Niño episodes (a heat discharge mechanism in the Pacific Ocean) have caused some of the extremes of the warming.

KNOWLEDGE GAPS AND ENGAGING THE STAKEHOLDER

Lynne Carter, Visiting Scientist and education specialist at the University of Rhode Island, reported on her study of behavior changes in participants of a climate change conference. She enumerated factors accounting for improved motivation and effectiveness among participants in addressing climate change issues. Carter said that while the "majority of people in this issue recognize that there are two important sources of climate change: natural and human activities," environmental knowledge among Americans is generally very low. She said that major efforts are required to give people the factual basis for the climate crisis, because the motivation to change usually depends upon confidence in understanding issues and being able to talk about them with friends, family and work partners.

The results of her study found that involvement in a two-and-a-half day National Informal Educators Workshop and Video Conference on environmental issues caused participants to implement many personal and professional behavioral changes. These changes included the use of fewer resources, assessing purchasing choices and options, recycling, and increased awareness and discussion of environmental issues. The benefits from participating in this exercise were long-term effects, measured a full eight months following the event.

Carter is convinced that "making the environment personal," acquiring specific environmental information, increasing confidence in understanding the issues and approaching new material, and seeing a connection between local concerns and national movements, are all essential to personal behavior change. She also believes in the strength of groups to solve problems and break out of old ways, especially when the whole population is now handicapped by societal structures that promote, in her words, "unbridled growth."

Norman Willard, Climate Change Coordinator for New England EPA, briefly described a new Office of Environment and Economy Group that was established to encourage states to perform greenhouse gas emissions inventories; it will also provide incentive funding for developing less carbon intensive technologies. Also, there are approximately three million dollars in educational program money for the current federal fiscal year beginning October 1st. EPA's various energy conservation programs, including "Green Lights" and "Energy Star" building construction and appliance ratings are continuing as programs to promote energy conservation and help reduce global warming. Most EPA efforts to improve industrial emissions performance are still voluntary and market driven.

INTEGRATED ASSESSMENT CHALLENGES

Ronald Prinn, Professor and Director of the Center for Global Change Science at Massachusetts Institute of Technology, presented the results of computer models simulating economic and climatic implications of several levels of control on greenhouse gas emissions. Prinn noted that current uncertainties regarding rates of economic development and climatic response to greenhouse gases allow a wide range of plausible predictions for temperature increases by the year 2100 (e.g., 2 to 9° F).

He noted that current European Union proposals to roll-back greenhouse gas emissions to stabilize atmospheric CO_2 levels at 550 ppm would decrease climate effects (such as global warming and sea-level rise) in 2100 by one-third at most; if the response of climate to greenhouse gases is at the higher end of current predictions, this is still not enough to prevent major environmental damage and social problems. Further, not even unilateral reductions by industrialized countries would offset the increasing emissions expected from developing countries, including China, India, Brazil, and Southeast Asia.

Prinn believes that international cooperation is essential and that U.S., Europe, Japan and others will have to offer developing countries major incentives to moderate their emissions from accelerating development.

DISCUSSION OF FINDINGS AND CLOSING REMARKS

The final plenary session was a discussion of the findings from the seven breakout groups, presented by the session chairs and moderated by **Berrien Moore III**. Through the presentations,

which represented the culmination of two days of responding to the four questions with observations, data, and insights, a glimpse of the New England and upstate New York region's vulnerabilities, knowledge gaps, and response strategies to climate change issues began to emerge. Even with planes to catch and other commitments on their calendars, most of the group stayed until 6:00 p.m. learning from each other and considering next steps. The participants agreed that the workshop was but an important "first step" to what many hope will grow into a collaboration between area stakeholders and researchers interested in identifying, monitoring, and mitigating global change at the regional level.

Tom Baerwald, Deputy Assistant Director for Geosciences at the National Science Foundation (NSF) brought the workshop to a close with several upbeat and relevant remarks. Baerwald echoed the sentiments of the participants by stating that on behalf of NSF he felt the workshop was "very much a success." This workshop, along with others like it across the nation, were bringing a "better, richer understanding of the fully integrated set of issues" that are involved with climate change. He cited the fact that in the past the global change research program has focused on physical sciences, the atmosphere, and the oceans—the New England Regional Climate Change Impacts Workshop and other regional workshops are highlighting the importance that people and regional ecosystems play in the equation.

Baerwald's congratulations were extended to the Steering Committee and Planning Committee and to all participants for an actively involved workshop which enhanced the network of communication among scientists and stakeholders and resulted in "a couple of very valuable days." He emphasized that this event was a first step in a series of on-going events designed to address, at a regional level, the significance of global climate change. He heartily encouraged all participants to remain involved in the process stating, "workshops don't get things done, it's the people within them who get them done." Scientists, policy makers, and federal agencies will need to continue the dialogue and interaction with "those people who are out in the real world" in order that the science and policy surrounding climate change will be more direct and focused.

In closing, Baerwald asked that New Englanders modify their successful "minuteman strategy"—citizens rising up in defense, at a minute's notice, against a challenge from a common enemy—as the federal government modifies its strategies so that in future engagements the different roles are not adversarial but roles where the regions and the nation can work together to address the challenge of climate change.